

Analysis of the Approach to Parasitic Cycles in Brazilian Science Textbooks as a Tool for Education in Health and Environment

Nathan D. C. S. Simplicio & Bianca C. Cordova & Eduardo C. Oliveira-Filho
Centro Universitário de Brasília – UniCEUB, BRAZIL

•Received 29 January 2016 •Revised 30 March 2016 •Accepted 31 March 2016

Modifying the environment is a characteristic of the human species. With deforestation and the expansion of urban centers, diseases known in animals have begun to be described in humans. Science textbooks constitute an instrument of great importance in understanding this issue. This study evaluated the main science textbooks, recommended by the Brazilian Textbook Guide 2011, for the 6th grade of middle school, covering the parasite cycles and analyzing the vector/host relationships as well as man's participation as an inducer/victim. The final analysis showed that most textbooks link image and text, but the cycles are presented off-scale and there are gaps which hinder the understanding of reality. As regards the environmental question, none of the analyzed books presented human beings as an inducer of cycles, and only a few reported the lack of sanitation, urban infrastructure and environmental degradation as causes of disease.

Keywords: science textbooks, tropical diseases, environmental education, environmental pollution.

INTRODUCTION

An important topic that should be approached in the teaching-learning process is how humans interfere with cycles of disease, because the lack of such information often ends up damaging the students' understanding of reality, leading to erroneous commonplaces and an incorrect view of scientific phenomena, affecting scientific learning (de Posada, 1999).

An example is the history of Chagas disease in Brazil. Briceno-Leon (2007) points out that the existence of the disease has long been known in the Amazon, but suggests that the increased incidence of this disease occurred as a result of urbanization and deforestation. It is observed that the capacity of the human being to modify the environment is a fundamental part in the cycles of various diseases, for those that were previously known only in animals have begun to be described in

Correspondence: Eduardo Cyrino Oliveira-Filho,
Centro Universitário de Brasília – UniCEUB, s/n - 707/907 - Asa Norte, Brasília - DF,
70790-075, BRAZIL
E-mail: eduardo.cyrino@embrapa.br
doi: 10.12973/ijese.2016.345a

humans after this began to expand urban centers. Borges (2001) states that dengue virus was primarily wild, circulating only among apes. This study suggests that, by the eighteenth century, dengue became a human disease thanks to urban environments that provided some vector species with shelters and breeding sites and also greater availability of hosts. With this, it is perceived that human presence has induced environmental changes that favor the inclusion of diseases in the population.

A number of waterborne diseases continue to expand around the world because of environmental degradation due to urban expansion and the growth of agribusiness. A case known in the tropics is schistosomiasis which, geographically, has expanded steadily in recent years due to the growth of agricultural areas, with cases reported lately in 52 countries, according to the World Health Organization (2013). Of these, 40 countries are located in Africa, two in the Americas, five in the Mediterranean, one in Southeast Asia and four in the Pacific), with Brazil being the country most affected by this disease in the Americas (Rey, 2008). This neglected disease mainly affects poor rural populations, who have not had an improvement in living conditions or effective proposals for public education to help combat its spread.

All these aspects, among others, show the close relationship between the presence of human beings in the environment and the changes caused, thus promoting the emergence and spread of diseases that were frequently non-existent before.

The analysis of textbooks is quite popular in academia. Batista and Rojo (2005) in a simplified search for the Lattes Platform of the Brazilian Scientific and Technological Development (CNPq), between the years 1975 and 2003, identified 5,480 titles that approached the topic of textbooks, but only 39 were related to the Sciences. This shows that even if there are several studies on the subject, there is a lack of information about how textbooks are used and whether their content is appropriate and well addressed to the target students. Santos and Carneiro (2006) confirm this information, showing that even if the textbook topic is old, it has still not been explored extensively.

Brazilian education

Brazilian education has recently undergone some changes, so that the student is led to critically reflect on the environment in which they live and to prepare for an increasingly demanding and competitive market. Thus, the World Declaration on Education for All (Ministry of Education [MEC], 1998a) highlights that:

[...] Everyone [...] must be able to benefit from training designed to meet their basic educational needs. These needs comprise both the essential learning tools (reading, writing, speaking, calculation, problem solving) and also the educational content (concepts, attitudes, values), which the human being needs to live and work with dignity, to participate fully in development, improve the quality of his/her existence, take enlightened decisions and continue to learn (p.17).

This statement illustrates the vital role that education is considered to play in shaping students not only as professionals, but also as citizens and members of society.

According to the Brazilian National Curriculum Parameters (PCN) (MEC, 1998a):

Learning concepts frequently presupposes working with facts (names, images, representations), which may occur in the first instance in an eminently mnemonic way. Memorization, seen as feature that makes the student capable of representing information in a generic way (significant memory) in order to relate it to other content, is an essential part of learning, provided it is not seen as mechanical and meaningless for the student (p.76).

It is inferred from the foregoing that concepts should always be well explained to avoid misunderstanding and that they should also bear a clear relationship with the real world to ensure that they do not seem unimportant to the student.

With respect to science education for middle-school students, the PCNs warn that a lack of scientific and technological information can leave children at the mercy of commonly held beliefs, widely publicized by advertising and other media, which may even hinder their formation as citizens (MEC, 1998b). They highlight the importance of science education, not only as part of the formation of concepts and names for the students, but also as an important tool in their process of understanding the world they live in.

The Textbook and the Brazilian National Textbook Program (PNLD)

One important aspect that should be noted in the teaching-learning process is the textbook, because this is what will help to guide the student during their academic formation. In Brazil, textbooks are chosen by evaluators within the Ministry of Education (MEC), who prepare the Guide to Textbooks for schools.

These choose whether to accept the books from the Ministry and they can apply this decision to all the disciplines or only a few. The decisions and choices of textbooks are then sent to the Education Secretariat of the city (or county), which will intermediate between the Ministry and the school (MEC, 2016).

The historical distribution of textbooks in Brazil dates from 1929, when the State created the National Book Institute (INL), which had the function of giving greater legitimacy to the national textbook and encouraging their production. In 1976, with Decree No. 77170 of February 4, 1976, the INL was closed and the government assumed the purchase of a large portion of books to distribute to a considerable number of schools. At that time, the National School Supplies Foundation (Fename) became responsible for the implementation of the textbook program, with the National Fund for Educational Development (FNDE, 2016a).

With Decree No. 91542 of August 19, 1985, the Brazilian National Textbook Program (PNLD) was created, bringing about several changes, among them the indication of textbooks by teachers, and the reuse of books. In 1995, the distribution of textbooks was gradually universalized across elementary and middle schools, and in that year Mathematics and Portuguese were included in this distribution program, in 1996 Sciences and, in 1997, History and Geography.

Finally, with resolution CD/FNDE 38 of November 14, 2004, the National Textbook Program was established for High Schools (PNLEM), universalizing the distribution of textbooks to all elementary, middle and high school students.

For better organization of the Brazilian PNLD, the distribution and preparation of the Textbook Guide is done in alternating three-year cycles. So every year students of an educational segment are targeted. Currently, the middle school segment has just completed the three-year period 2011/2012/2013 (MEC, 2010) and is almost completing the three-year cycle of 2014/2015/2016 (MEC, 2013). The Textbook Guide explains the positive and negative aspects of the books suggested by the Ministry of Education. It is shown if the pedagogical proposal is clear, if the content is appropriate, if the book encourages research and experimentation, among other aspects defined in the guidelines for the evaluation and selection of teaching materials (MEC, 2009).

The science book in turn brings to the student a theoretical view of the phenomena observed in nature, so it is particularly important to highlight the use of the book to introduce key concepts in the classroom. Unfortunately, many teachers start from the premise that the book is nothing more than a mere book of exercises and that the figures contained in the work do not need much depth as they are "self-explanatory" (Santos and Carneiro, 2006; Silva et al., 2006). According to the

Textbook Guide, the science book should be a support tool for the construction of concepts and inspiration for students and even for the teacher (MEC, 2010, 2013); in other words, it does not need to be followed in a linear way, but in the way that best makes sense for the subject (de Posada, 1999).

There are several definitions to characterize a textbook. In one, the textbook is considered a printed instrument structured to support the learning process (Gérard and Roegiers, 1998). In a more recent view the book is seen as printed material produced by publishers to serve the teaching-learning process in basic education (Batista and Rojo, 2005; Santos and Carneiro, 2006). In both definitions it is seen that the book should be a tool for the student's study and for structuring the teacher's lessons, in practice we note that it is used in class only to provide exercises for the student (Santos and Carneiro, 2006), leaving the steps of reading and interpretation of texts and schemes in the hands of students.

Visual illustrations in the books and disease cycles

In a study with chemistry textbooks from the 1970s, Mortimer (1988) found that, on average, 30% of the books were occupied by texts and the rest filled with exercises and illustrations. Comparing with today's textbooks, it is clear that visual appeal has become more notable than textual in the last 40 years.

Silva et al. (2006) emphasize that the use of images is a fundamental tool in the teaching-learning process, but agree that the teacher plays a vital part in deciding how this feature will be used in the classroom. This means that he or she will choose which images to use and in which activities they will focus on the images. These authors also admit that in science textbooks, the use of images by the author demands care and attention, because even if it seems to be something simple and unimportant, each person has a different level of interpretation of a single image.

Regarding the way in which teachers work with concepts and link them to images, the parasitic cycles of diseases are important aspects that require caution, because even if the methods of prevention and infection are worked through exhaustively, some aspects are not effectively dealt with. The student often draws his or her own conclusion, which is frequently based on popular misconception (Gurung and Landrum, 2012).

Rozemberg (1998), working with a rural community in an endemic area of schistosomiasis, proved the foregoing, reporting that there is a certain shame on the part of teachers to refer to a specific but important aspect of the disease cycle with their students. The act of a sick person defecating near a water body features a vital step in the schistosomiasis cycle; however, the simple act of referring to a person defecating causes embarrassment to the teacher and derision on the part of the students.

Other work associated with disease cycles aimed to evaluate the knowledge of middle-school students about the dengue cycle and to perform an intervention to raise awareness among students about the correct measure of disease control (Madeira et al., 2002). As a result, it was observed that students have become more able to recognize the stages of the disease cycle, and prophylaxis methods are more efficient and viable. This study also suggested that joint participation between students and teachers can improve knowledge about the disease, and not allow learning to be restricted to books and lead to possible misinterpretations of the topic under study by the students.

In work with students in an endemic area of schistosomiasis, Oliveira et al. (2008) found that students cannot perceive the responsibility that human beings have within the parasitic cycles of disease. Following the same line of research, also working with students from middle school, Aragão (2011) realized that they have

difficulty in contextualizing the content learned within their everyday experience, which would lead them to understand better the ways the disease is transmitted.

In both cases presented, the authors show that there is a lack of association between humans and the disease cycles, because the content is only emphasized by books and teachers, without showing students this topic in their daily life or pointing out how humans can interfere in the disease cycle. de Posada (1999) confirms this perception when points out that when the real-life experiences of students interact with the scientific knowledge of the teacher, students try to reconcile their mental models with acceptable scientific concepts.

Therefore, this study aimed to evaluate science textbooks recommended for public schools and distributed during the PNLD 2011, with regard to their treatment of the parasitic cycles of diseases and the relationship between vector and host, as well as the participation of human beings as promoters/victims of those cycles.

METHODOLOGY

Science textbooks recommended by the Brazilian Textbook Guide 2011 (MEC, 2010) were selected for the 6th grade of middle school, as indicated in Table 1. In the analyzed group were included six of the 10 recommended books, and the selection criteria were based on the books most sold, according to data presented in the hyperlink of the Brazilian National Foundation for Educational Development (FNDE, 2016b) and the availability of the books for purchase.

In the overall analysis of the textbooks, the sections that focused parasitic diseases that have the participation of wildlife as intermediate hosts or vectors were examined. The textual approach towards the theme and the figures used to illustrate the parasitic cycle were analyzed.

The image-text relationship was examined if the text referred to the image, identifying the function and assisting in its understanding and interpretation. The method used for this was proposed by Jotta and Carneiro (2009), in view of the similarity between this work and that of the above authors.

For individual analyses, we evaluated if the text makes it clear that humans participate as inducers and not only as victims of parasitic cycles of diseases; and if public health strategies, sanitation and environmental education can be more effective in the prophylaxis of the disease than the simple elimination of the intermediate host. We observed whether the analyzed works presented technological innovations and findings in science and, in addition, the presence and the type of labeling on images. We examined if they were synthetic (only including information that is seen) or explanatory (having explanations about the illustration).

It is emphasized that access to the textbooks used in this study was achieved with the support of teachers and public institutions, and all rules governing the copyright of the authors have been preserved.

Table 1. Science textbooks recommended by the Brazilian Textbook Guide 2011 and analyzed in this study.

Authors	Book title	Publisher/ Town	Year
Fernando Gewandsznajder	Ciências: A vida na Terra	Ática, São Paulo	2009
Jenner Alvarenga et al.	Ciências Integradas	Positivo, Curitiba	2008
Eduardo Canto	Ciências Naturais: aprendendo com o cotidiano	Moderna, São Paulo	2004
Carlos Barros and Wilson Paulino	Ciências: Os seres vivos	Ática, São Paulo	2009
Ana Maria Pereira, Margarida Santana and Monica Waldhalm	Perspectiva Ciências	Editora do Brasil, São Paulo	2009
Leonel Favalli, Karina Pessôa and Elisangela Angelo	Projeto Radix: Ciências	Scipione, São Paulo	2009

RESULTS

General analysis of textbooks

In the books studied a pattern of parasitic diseases was noted across the phyla of the Animal Kingdom. Where they were seen in different modules in which every chapter described a phylum of the Animal Kingdom, there were references to disease cycles at the end of the chapter. The exceptions were in Alvarenga et al. (2008) and Canto (2004), which had a separate chapter to deal with the subject of parasitology.

For some diseases no schema were presented for parasitic cycles, with these being explained in a direct manner through the text in some books or simply not discussed in others. The table below (Table 2) shows the occurrence of each cycle per book.

The cycle of Chagas disease was found in practically all the books, with only Canto (2004) choosing to present it in a strictly textual manner, without the support of an image to describe the cycle.

For dengue, we found no cycle in the studied books, but dengue is approached textually in all the books, except in Alvarenga et al. (2008) and in Favalli et al. (2009).

Schistosomiasis was approached both textually and visually in all the textbooks studied.

For filariasis, Gewandsznajder (2009) proposed a cycle for the disease, while the other authors only reported the disease. It was not found in the book by Canto (2004).

The leishmaniasis cycle was not illustrated in any book, and only Gewandsznajder (2009) and Barros and Paulino (2009) described the disease in a chapter; Alvarenga et al. (2008) mentioned the existence of this disease.

Malaria was visually approached through a parasitic cycle by Gewandsznajder (2009), Pereira, Santana and Waldhelm (2009) and Favalli et al. (2009). In the remaining books, it was approached textually and only cited by Alvarenga et al. (2008).

In all the books it was noticed that the subtitles, when present, explained that photos and schema were out of proportion (for example, giant vectors) and with colors that do not represent reality.

In the works by Gewandsznajder (2009), Pereira et al. (2009) and Favalli et al. (2009), the concepts of *intermediate host* and *definitive host* are shown only in the flatworm chapter, leaving the cycles in the previous chapters without identification of hosts.

Only Gewandsznajder (2009) and Pereira et al. (2009) subtly suggested that the vector has an ecological importance when proposing biological control without the use of agrochemicals, or using them as a last resort.

Table 2. Parasitic cycles illustrated by book.

	Chagas	Dengue	Schistosomiasis	Filariasis	Leishmaniasis	Malaria
Gewandsznajder, 2009	+	-	+	+	-	+
Alvarenga et al., 2008	+	-	+	-	-	-
Canto, 2004	-	-	+	-	-	-
Barros and Paulino, 2009	+	-	+	-	-	-
Pereira et al., 2009	+	-	+	-	-	+
Favalli et al., 2009	+	-	+	-	-	+

Note: + Cycle presence; - Cycle absence.

As technological innovations, Pereira et al. (2009) was seen to be outdated for proper prophylaxis of malaria, by proposing that this could be done with quinine-based medicines. Almost no book addressed the new form of contagion with Chagas disease through the açaí, with only Gewandsznajder (2009) reporting that this disease can be contracted by consuming food contaminated with the insect feces.

To better discuss the results found, the individual analyses of some of the parasitic cycles found in the studied books will be seen below.

Individual analysis of textbooks

In the book by Gewandsznajder (2009), it was noted that some cycles are not presented in a continuous manner, thus not making it clear at what moment the cycle starts and how it triggers the disease. In all cycles seen in the book, the author confirms the danger of self-medication; however, with regard to prophylaxis he does not explain the toxic effect that the use of insecticides and molluscicides may cause to the environment. The reference to the image occurs after the explanation of the whole cycle.

The concepts of intermediate host and definitive host are only presented later in the book in the flatworm chapter, during the presentation of the taeniasis cycle, leading to a shaky understanding of the cycles in the previous chapters.

The author emphasizes the importance of sanitation at some points in the book when we read phrases like "Again, you can see how the lack of sanitation contributes to the transmission of verminosis" (Gewandsznajder, 2009, p. 106). All captions are only synthetic, indicating what is being seen, that the color image is not real and that the drawings are out of scale.

Alvarenga et al. (2008), in turn, devote an entire chapter to the study of parasitic diseases, showing the importance of hygiene and sanitation practices in the prevention of parasitic diseases. However, even having explained the cycles with a wealth of technical information, some cycles such as dengue, malaria and leishmaniasis were not found in the book.

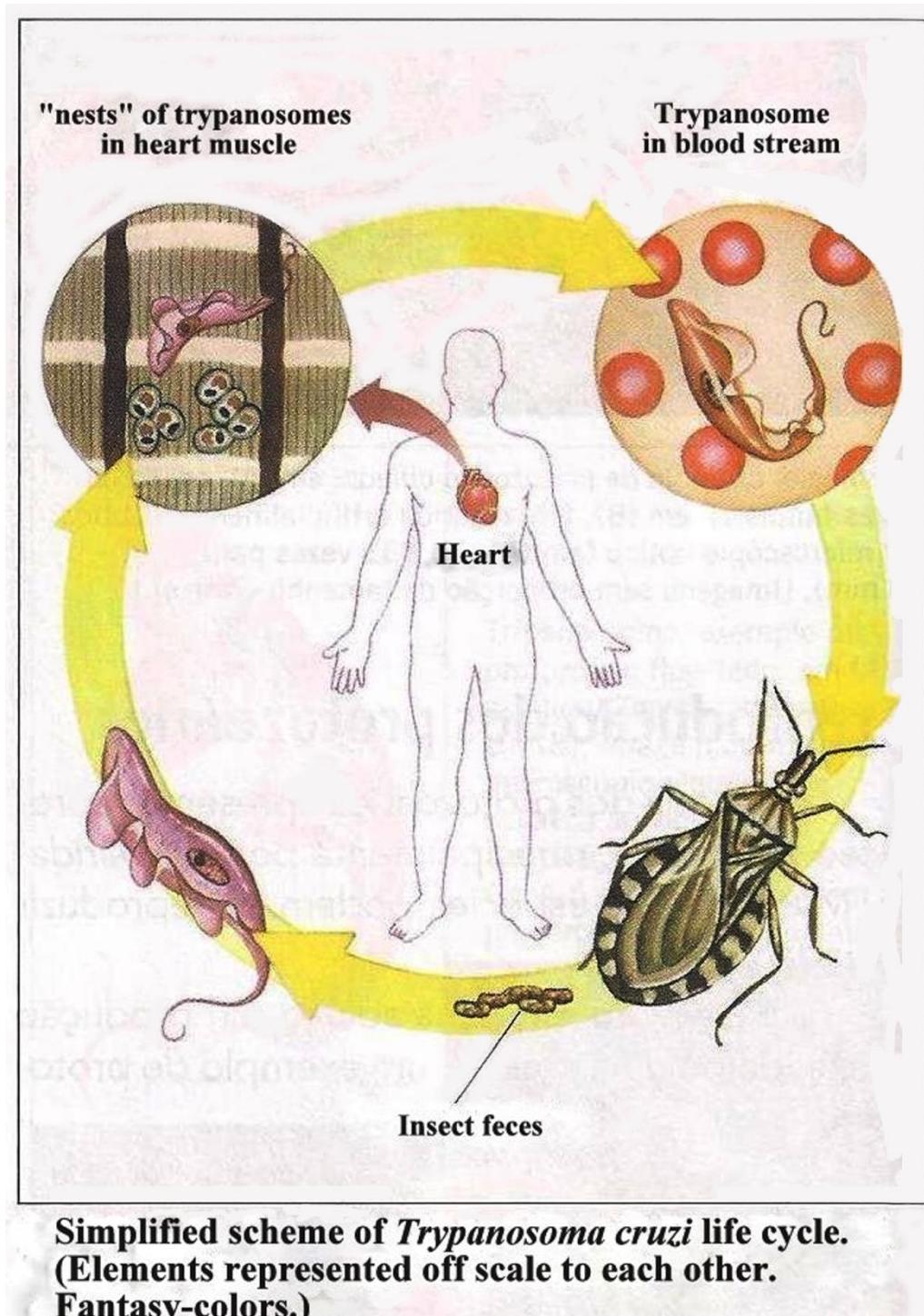
For some cycles, such as schistosomiasis, no explanation of the disease was given in the text, still less in the caption, which has a synthetic function and indicates that the drawings are out of scale. Instead of this, readers are instructed to "observe the life cycle of this parasite in the illustration below" (Alvarenga et al., 2008, p. 118) and then it was proposed to make a text explaining the disease cycle seen in the illustration.

Canto (2004) also devotes an entire chapter to the study of parasitic diseases, but in this chapter discusses only schistosomiasis, taeniasis, the hookworm and ascariasis, leaving Chagas disease, malaria and dengue to another chapter.

In none of the studied cycles was the disease prophylaxis method found and only in some were the symptoms of the disease presented, not taking the student deeper into the content in, for example, dengue, where the author shows only the vector of the disease and proposes in a section titled "teamwork" that the students make a group to research more deeply each viral disease to be presented to the class.

In the schistosomiasis cycle, in particular, reading becomes confusing, as initially the author argues that the vector of this disease lives in uncontaminated fresh water, but then says that the disease is transmitted through contaminated water. This would demonstrate infeasibility, since there would be no way for the parasite to develop, since the intermediate host is not present in the same environment.

In the book by Barros and Paulino (2009), the cycles are, in general, presented in a very simple way, as illustrated by Figure 1, but the text has a more complete explanation of the cycle and complements the figure, indicating where the cycle begins and where it closes. However, for the Chagas disease cycle no references to the image were found in the text.



**Simplified scheme of *Trypanosoma cruzi* life cycle.
(Elements represented off scale to each other.
Fantasy-colors.)**

Figure 1. Chagas disease cycle found in the book. Image Joel Bueno/Publisher archive

For some cycles, such as malaria and filariasis, the cycle was presented just in the textual manner, and in some parts reading became tiresome and confusing.

In all studied cycles the author cites vector eradication as a prophylactic method for the disease, but adds that chemical control may be used "as a last resort, and with proper guidance and cautions" (Barros and Paulino, 2009, p. 62) and "adopting the proper care when applying these chemical agents" (Barros and Paulino, 2009, p.

84). Nothing is said about the care that must be taken and any effects that chemical agents can cause in the environment and in humans.

In the work of Pereira et al. (2009) it was observed that the cycles are presented in a simplified manner and without much detail. In none of texts was any reference made to the image so that the student can complement reading. Some parts of the book, such as "(plasmodia) are injected (...) in human blood circulation" (Pereira et al., 2009, p. 104) and "the cercariae leave the snail and penetrate the human skin when it enters in contact with the contaminated water" (Pereira et al., 2009, p. 134) are confusing to read and may complicate students' understanding of how the parasite enters the human body.

In the prophylaxis, in all cases, the author states the eradication of the vector as the first choice and, in diseases such as Chagas, explains that this is a social disease and the improvement of urban infrastructure and living conditions can prevent the illness and, only in this disease, does not mention the use of pesticides.

During the analysis of the book, it was observed that terms such as "prophylaxis" and "host" were explained during the presentation of parasitic cycles, but important words such as "intermediate host" and "definitive host" were presented only in the chapter on flatworms and roundworms and, in turn, the concept of those words was not explained.

Finally, in the book by Favalli et al. (2009), it was found that the cycles, when present, were accompanied by a short explanatory text (Figure 2). Chagas disease, malaria and schistosomiasis had more explanation in the figure than in the text itself, where only generalities of the disease, parasite characteristics and prophylaxis of the disease were presented.

As prophylaxis, in all cases, vector eradication is proposed as the primary solution and also the use of larvicides against the etiological agent (if possible). Only in the Chagas disease cycle does the author warn of the dangers of pesticides to the environment, but does not explain what these are.

Ciclo de vida do plasmódio

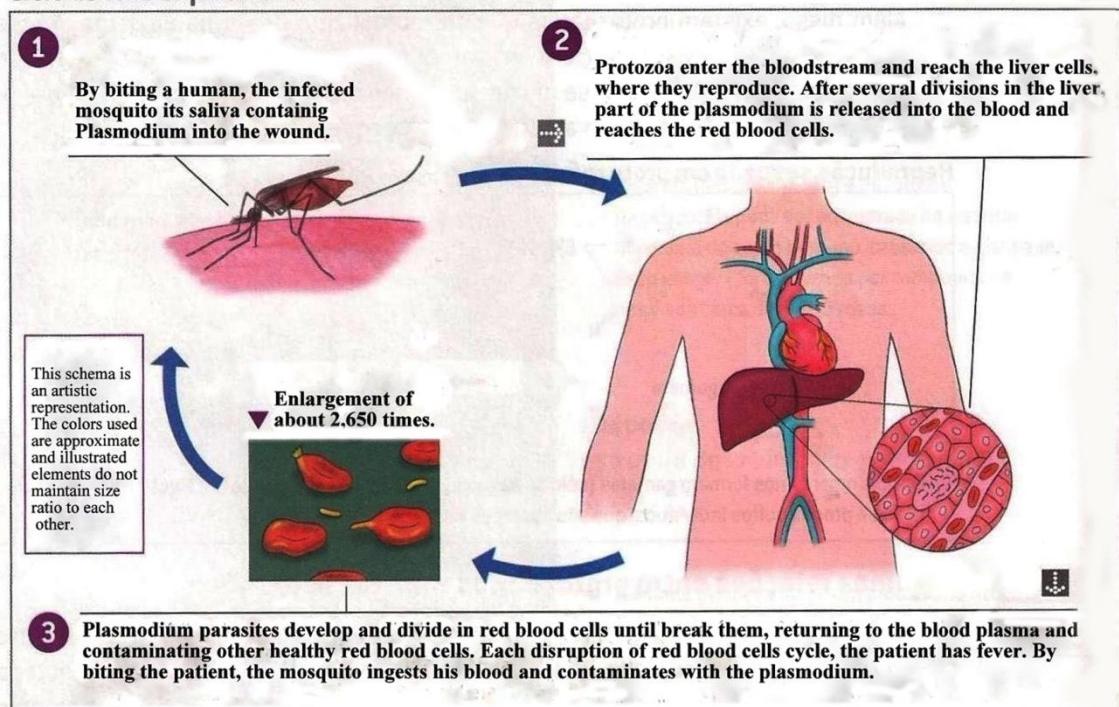


Figure 2. Malaria cycle found in the book. Image Nelson Ishikawa/Publisher archive

For schistosomiasis prophylaxis, among those already mentioned, the author also suggests avoidance of possibly contaminated water bodies, but does not illustrate how to identify if the site is contaminated.

DISCUSSION

Among the studied books, it was noted that only two had a chapter that specifically aimed to discuss the issues of parasitic diseases. A chapter focused on parasitism is more appropriate, because it shows a concern with the relationship between living beings, giving a more ecological than taxonomic approach. In addition, approaching the parasitology content within taxonomy can often restrict the understanding of the subject only to the biological aspect, leaving out the health and environmental aspects (Jotta and Carneiro, 2009; França et al., 2011).

In the analysis of prophylaxis and drug interactions, Gewandsznajder (2009) mentions the risks of self-medication, but does not explain the toxic effects it can cause in humans. The textbook, as an essential tool in the intellectual development of students, should deal with health education more actively, because it is supposed to "form individuals that are more aware of the factors that can help them to maintain good health and prevent diseases" (Vinhos et al., 2009, p. 294). This includes in particular access to information about the risks that the administration of drugs without prescription brings to the body, yet the disease control programs still pay little attention to health education projects focused on the prevention and control of diseases (França et al., 2011).

For malaria, especially in the book by Pereira et al. (2009), the statement was found that drugs containing quinine and derivatives can help prevent the disease, but Boulos et al. (1997) warn of the toxic effects that quinine can cause in the organism and the low effect that it has if administered for fewer than 7 days. These facts are not detailed in the analyzed book.

When we compared what was found in this study with the evaluation by MEC that is published in the Textbook Guide (MEC, 2010), we can see that the Guide itself points out that not all the books from the collection fulfill all of the 6th grade syllabus. Indeed, the book by Barros and Paulino (2009) is considered too advanced for the grade that it targets, and that by Pereira et al. (2009) is considered too childish in some situations. Only the book by Gewandsznajder (2009), according to the Guide, complies with all the content in an accessible manner for the student.

As for the graphic design of books, the guide points out, in general, that all the books have acceptable image quality, but the books by Alvarenga et al. (2008); Barros and Paulino (2009) and Pereira et al. (2009), are said to have some inadequacies and omissions in their images that can be misleading. During the analysis of these books inadequacies were not observed, but only an oversimplification of some images; if this is not pointed out by the teacher it can be misleading.

Silva et al. (2006) argue that teachers have a certain resistance to learning from and discussing images in the classroom because they start from the premise that the images "speak for themselves", but small details in the image provide space for various interpretations. Thus, both publishers should seek to improve the graphic design of their books not to allow misinterpretations, as teachers need to open more spaces within their classes for discussion and analysis of the image (or cycle) they are studying.

The Textbook Guide shows that all the studied books have some of their content focused on environmental and health issues, but confirms that in the case of the work of Alvarenga et al. (2008) this emphasizes little about how to mitigate and solve the problems that the author identifies in his chapters. Although we noted a limited environmental approach in all analyzed books, it was seen that the book by

Alvarenga et al. (2008), in particular, focuses more on how individual actions can solve environmental and health problems. Thus, if the teacher wants to highlight a wider view of the subject to the student, he or she will need to show that public policy planning and legislation may be more appropriate to address these problems than just individual actions.

Some diseases, such as leishmaniasis and dengue, have high prevalence in Brazil not only because of the lack of individual actions, but also because of little investment in developing new drugs and also due to the low effectiveness of prevention and control programs (Lindoso and Lindoso, 2009), which seek to focus their actions more on vector combat than on environmental education practices.

In this study, another aspect found in all the studied books, regarding the environmental focus, was the lack of linkage between public policies for sanitation issues, urban infrastructure and environmental degradation, suggesting that these problems are unrelated to human will.

Justi and Gilbert (1999) and Megid Neto and Fracalanza (2003) point out that Science textbooks for middle school view students as passive beings, oblivious and unable to alter scientific knowledge, by presenting this as an absolute and unchangeable truth. This attitude in textbooks, as noted by the authors, only ratifies the data in this study, since if the relationship between human beings and environmental degradation is not presented, the student can understand that this process is independent and unattainable.

Understanding that the biological sciences are constantly being updated, it is emphasized that little has been seen in books about new forms of disease transmission. While most teachers and authors only know that Chagas disease is transmitted by the bite of an insect, a new form of contagion has recently been described by means of a food widely consumed by the Brazilian population. Even though this new form was only scientifically reported by Pereira et al. (2010), since 2006 there has been a suspicion that Chagas disease could be transmitted also by açaí consumption.

In this context, only Gewandsznajder (2009) reports that Chagas disease can be contracted by consuming food contaminated with the insect feces, but places little emphasis on the importance of food hygiene.

CONCLUSIONS

In general, the studied books showed a relationship between the image and the text used, but the aspects of environmental concern and how humans can intervene in the disease cycle should be better explained by all authors.

Within the methodological proposals presented in this work, it was noted that publishers tend to standardize a content template, using the theme of disease cycle within the taxonomy chapters and seeking to place the concepts of intermediate host and definitive host in the chapter of flatworms, more specifically, when the taeniasis cycle is shown. This creates a gap in the cycles that were previously studied, where the teacher needs to return with the students to these chapters if he/she wants to reinforce the concept with them.

We conclude that none of those studied books discussed the theme of human beings as inducers of disease cycles, with only one or two authors showing the risks that may be caused to the environment when using inadequate control methods.

Considering the dynamics of human beings within the disease cycles, none of the books analyzed pointed out the presence of human beings as an inducer of parasitic cycles, stating only that the lack of sanitation and urban infrastructure, and environmental degradation, are the causes of some of these diseases.

It is suggested for the triennium that is going to start for middle schools (PNLD 2017/2018/2019), where textbooks are again updated and submitted to evaluation,

that publishers and their respective authors should seek a more environmental approach, trying to emphasize higher interaction between ecology and parasitology, and the role of humans in environmental degradation. It is also expected that themes related to parasitic diseases should be updated, including, among other things, the relationship between açaí, hygiene and Chagas disease.

Although comparison was not one of the objectives of the present study, it was noted that the book by Gewandsznajder (2009) was the one that dealt best with the issues analyzed in the work, both in graphic design, and in explaining the cycles and the risks of chemical remediation. However, a better review of the content shown in this book is also recommended, especially with respect to the risks of urban and rural development for the spread of diseases. This subject should be presented as something intrinsic to the human being and not as an external phenomenon.

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